

CLAIMS

What is claimed is:

1. A fuel cell system comprising:

at least one cathode section having an inlet and an outlet;

at least two anode sections each having an inlet and an outlet;

wherein said at least one cathode section and said at least two anode sections are operable to convert an oxidant-containing cathode reactant and a hydrogen-containing anode reactant into electricity, a cathode effluent and an anode effluent;

a first flow path operable to supply a first anode reactant feed stream to an inlet of a first anode section of said at least two anode sections;

a second flow path operable to supply a second anode reactant feed stream to an inlet of a second anode section of said at least two anode sections;

a first valve in said first flow path operable to modulate flow through said first flow path;

a second valve in said second flow path operable to modulate flow through said second flow path;

a third flow path connecting an outlet of said first anode section to an anode outlet of said second anode section thereby providing flow communication between said first and second anode sections through said outlets; and

a third valve communicating with said third flow path and operable to modulate venting of anode effluent from said third flow path.

2. The system of claim 1, further comprising:
 - a forth flow path operable to supply a third anode reactant feed stream to said third flow path; and
 - a forth valve in said forth flow path operable to modulate flow through said forth flow path.
3. The system of claim 2, wherein said forth valve is a proportional valve that regulates a quantity of said third anode feed stream flowing to said third flow path.
4. The system of claim 2, wherein said forth valve is operable to block flow through said forth flow path.
5. The system of claim 1, wherein said first and second valves are proportional valves that regulate a quantity of said anode feed streams flowing to said respective first and second anode sections.
6. The system of claim 1, wherein said first and second valves are each operable to block flow through said respective first and second flow paths.
7. The system of claim 1, wherein said third valve is a proportional valve that regulates a quantity of anode effluent vented from said third flow path.

8. The system of claim 1, wherein said third valve is operable to block venting of anode effluent from said third flow path.

9. The system of claim 1, wherein said at least one cathode section is a cathode portion of a single fuel cell stack and said at least two anode sections are an anode portion of said single fuel cell stack

10. The system of claim 1, wherein said first anode section is an anode portion of a first fuel cell stack and said second anode section is an anode portion of a second fuel cell stack.

11. A method of operating a fuel cell system having at least one cathode section and at least two anode sections which are operable to convert an oxidant-containing cathode reactant and a hydrogen-containing anode reactant into electricity, a cathode effluent and an anode effluent, the method comprising:

- (a) supplying a first anode reactant feed stream to a first anode section of the at least two anode sections;
- (b) supplying a second anode reactant feed stream to a second anode section of the at least two anode sections;
- (c) supplying an anode effluent from one of said first and second anode sections to the other of said first and second anode sections; and
- (d) adjusting a quantity of at least one of said first and second anode reactant feed streams being supplied, so that alternatively, said one and then said other of said first and second anode sections receives said anode effluent.

12. The method of claim 11, further comprising selectively venting anode effluent from the fuel cell system.

13. The method of claim 12, wherein selectively venting anode effluent includes continuously venting at least a portion of said anode effluent from the fuel cell system.

14. The method of claim 12, wherein selectively venting anode effluent includes burping the fuel cell system.

15. The method of claim 12, wherein selectively venting anode effluent includes discontinuously venting anode effluent.

16. The method of claim 12, wherein selectively venting anode effluent includes regulating a quantity of anode effluent vented from the fuel cell system.

17. The method of claim 11, wherein said adjusting includes varying said respective quantities based on an operating parameter of the fuel cell system.

18. The method of claim 17, wherein said operating parameter is a voltage stability of at least one of the anode sections.

19. The method of claim 11, further comprising separating at least a portion of water contained in said anode effluent from said anode effluent prior to supplying said anode effluent to the other anode section.

20. The method of claim 11, wherein said adjusting is based on empirical data.

21. The method of claim 11, wherein said adjusting is based on an algorithm.
22. The method of claim 11, wherein said adjusting occurs at a predetermined interval.
23. The method of claim 11, wherein said adjusting of said first and second anode reactant feed streams achieves up to about 120% of a hydrogen stoichiometric requirement of the fuel cell system.

24. A method of operating a fuel cell system having at least one cathode section and at least two anode sections which are operable to convert an oxidant-containing cathode reactant and a hydrogen-containing anode reactant into electricity, a cathode effluent and an anode effluent,

- (a) supplying a first anode reactant feed stream to a first anode section of the at least two anode sections;
- (b) supplying a second anode reactant feed stream to a second anode section of the at least two anode sections;
- (c) supplying a third anode reactant feed stream to the flow path connecting outlets of said first and second anode sections; and
- (d) varying a quantity of at least one of said first, second and third anode reactant feed streams being supplied.

25. The method of claim 24, further comprising selectively venting anode effluent from the fuel cell system.

26. The method of claim 25, further comprising ceasing the supplying of said third anode reactant feed stream when venting anode effluent from the fuel cell system.

27. The method of claim 25, wherein selectively venting anode effluent includes regulating a quantity of anode effluent vented from the fuel cell system.

28. The method of claim 25, wherein selectively venting anode effluent includes venting anode effluent based on an operating parameter of the fuel cell system.

29. The method of claim 24, wherein varying a quantity of at least one of said first, second and third anode reactant feed streams includes varying said quantity based on an operating parameter of the fuel cell system.

30. The method of claim 29, wherein said operating parameter is a voltage stability of at least one of the anode sections.

31. The method of claim 24, wherein varying a quantity of at least one of said first, second and third anode reactant feed streams includes varying said quantity based on empirical data.

32. The method of claim 24, wherein varying a quantity of at least one of said first, second and third anode reactant feed streams includes adjusting said quantity so that anode effluent from one of said first and second anode sections flows into the other of said first and second anode sections.

33. The method of claim 24, wherein varying a quantity of at least one of said first, second and third anode reactant feed streams includes varying said quantity so that at least one of said first and second anode sections receives two of said anode reactant streams.